KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, DECEMBER 15, 1882.

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Science and Art Gossip.

THE snowstorms of the last week impeded traffic much more seriously than much heavier snowstorms do in America. But this is not to be wondered at, for with us snowstorms of the kind are infrequent; in the Northern States of America not a winter passes without several of them, so that there they must be prepared for them at the penalty of very serious misfortune if they fail. Still, we might do better, especially in the large cities, and on important lines of railway traffic. A few more plough-engines, for example, to clear away the snow on the main lines, would be a desirable addition to the rolling stock of at least the Northern companies. In cities, improved arrangements for street-clearing are very much needed; but under the present system, which makes every pound saved at least ten shillings gained by those who ought to see to such matters, we are not likely to see soon a change for the better.

As may be supposed, the storm had a terrible effect on the telegraph service. North of the Trent the state of affairs was alarming. The poles carrying the wires were in many places blown down, while in other places the wires were rendered useless by being connected to earth by means of the vast accumulations of snow. It is easy to conceive that it would take some days to effect the necessary repairs. It is to be hoped that the lesson thus rudely bestowed by nature will not be forgotten.

WHAT one notices most, however, when we have a spell of bitter weather, is the utter inefficiency of our methods for warming even those who are willing to pay well for warmth. Our railway carriages are in this respect simply a disgrace to a civilised community. Any one who has to travel at night by a train without sleeping-cars has practically to travel at the risk of his life; for if the weather should be exceptionally cold, he has no means of protecting himself against it effectually, let his shawls and wrappers be ever so numerous or so thick. Even if he can keep his body warm he has to breathe cold raw air. Many a fatal attack of pneumonia has been brought on in night travelling in this country, though the sufferer has not died in the railway carriage, and so has not given evidence against the absurd inference, humorously drawn by Mr. Bright from statistics, that a man is safer in a railway carriage than in his bed-room.

THE transit of Venus was not on the whole well seen in Europe, though in some places favourable weather prevailed. We shall not here repeat the records which have appeared in the daily papers, stating where the transit was seen, where not, how many photographs were taken in this place or in that. The interest and value of all such observations can only be determined hereafter.

WE note, however, that at some places the arc of light seen in 1874 round the part of the disc of Venus which was outside the sun just before first internal contact and just after second internal contact, was seen on this occasion; but it was incomplete, forming two arcs or horns of unequal length, extending from the cusps of the solar disc, and only partially enclosing the body of the planet. This is very easily explained. The edge of Venus at the time of transit is, of course, that part of the planet's surface at which the sun is in the horizon (either rising or setting), for inhabitants of Venus, if such there be. The atmosphere of Venus along that region may be clear or clouded,—where clear, it would refract the sunlight, and the arc of light would be formed; where clouded, the sunlight would only be refracted *above* the cloud layer, and if this layer were three or four miles above the sea-level, as it might very well be, about one half of the atmosphere would be below, and ineffective in producing refraction. Here, therefore, the arc of light would be lost. [N.B. This explanation does not apply to Mr. Brett's Vitreous-Venus-Atmosphere Theory.]

A CORRESPONDENT ("Hallyards") writes as follows:—"The zodiacal light was certainly, but not very clearly, visible on several clear evenings of the last week. This is my seventh winter here (Pornic, Loire Inférieure, France), and I never before saw it till January. The fact may, perhaps, be worth noting, as possibly connected with the comet, great sun-spot, aurora, and electric storm."

AT LAST!—The Electric Power Storage Company (Limited) announce that from Jan. 1 they will be prepared to receive applications for the supply of electrical accumulators for lighting or motive-power, and for the undertaking of complete installations of electric lighting of districts, private houses, and establishments, railway trains, or ships.

A BILL has been prepared bearing the names of several Home Rulers, and will be introduced next session, to provide for the purchase of the Irish railways on or after Jan. 1st, 1884.

THE *Metallarbeiter* calls attention to a discovery affecting the utilisation of the coal tar and ammonia developed in blast furnaces, by processes more or less similar to those in use in the manufacture of gas. Those who know the important position occupied in gas companies' budgets by the proceeds arising from the sale of such products, will readily appreciate the value which such a discovery would possess for the iron trade if the description of its merits is correct.

TELEPHONE EXCHANGES.—Some interesting statistics have recently been published concerning telephone exchanges. It is stated that there are 12,325 subscribers in Boston, U.S., 4,060 in New York, 2,422 in Paris, 1,600 in London, 600 in Vienna, and 581 in Berlin. It is

estimated that there are upwards of 100,000 in the whole of the United States, certain small towns with a population less than 1,000 having 30 to 50 subscribers. Consequently, in these latter places, there is a telephone to every 20 inhabitants; while in New York and Zurich it is 1 to 200; in New York, 1 to 500; Brussels, 1 to 800; Paris, 1 to 1,000; Berlin, 1 to 2,000; London, 1 to 3,000; and St. Petersburg, 1 to 4,000.

We learn from the *Railway Age* (Chicago) that the Northern Pacific Railway is to run for some hundreds of miles under the shade of trees, planted to protect it from storms and snowdrifts on the open prairies. The company has set a large force of men to work at planting them, and is offering every inducement to the settlers on its property along the line to cultivate forestry.

In a leading article on the novelist whom we have just lost (and, for our own part, we deem such a loss far more serious to the world than many others about which much more is said), the *Times* makes the startling assertion that it is with Anthony Trollope's "Mr. Crawley" that Miss Austen's "Mr. Collins" must be compared, and leaves the impression that "Mr. Crawley" is a development in recent times of the "Mr. Collins" of Miss Austen's days! Could false criticism go much further than this? Could two characters, both clerical, be imagined much more unlike than the two here? If it had been Collins and Slope; but Collins and Crawley!—not contrasted—but compared! Crawley, whose worst faults were better than Mr. Collins's best virtues—supposing for the sake of argument that he had any positive virtues. We all of us love Mr. Crawley, even when we feel how much more truly brave was that dear wife of his; but as for Mr. Collins, one feels it would be a relief to see something in Mr. Collins worthy of so positive a feeling as hatred. What marvellous bits of drawing they both are! But it angers one to think that the man who could draw as Trollope did here, should have left so many crude and imperfect sketches.

I have long owed Mr. Walter Besant "one." I was in New Zealand, travelling from Dunedin, where I had given what I fondly regarded as a most successful course of lectures, to Christchurch, where afterwards I was as pleasantly received. I was "recuperating," *more meo*, by light reading, the particular book I was reading being the "Golden Butterfly." Alas, in full enjoyment of this most enjoyable book, I was suddenly confounded,—slapped, figuratively, in the face,—by finding my vocation (or one of my vocations) included, amongst others, as illustrations of the dreariest human experiences. "One might as well," wrote, in effect, Mr. Besant (I acquit the late Mr. Rice) "talk of enjoying a lecture on astronomy, or"—so forth and so forth. And now, at the beginning of his Christmas story, "Let Nothing You Dismay," Mr. Besant says the sun rose exactly at four (in North England), early in May. Unless a very wide meaning is given to the word "early," the sun could have done nothing of the sort, though he rises earlier there than in London (in May). True, a few pages later, the Fugleman implies (on the same day) that it is past the middle of May. But that is not my affair, any more than is the circumstances that Drury says "Ralph's eyes are blue" in one place, and a page or two further on that they are brown. I stand by the first statement that *early* in May the sun rose exactly at four; and maintain that this could not well have happened.

In the same pleasant story, by the way (for it should be hardly necessary to say that my wrath against Mr. Besant is not very warm—so that I still take pleasure in his stories), the mistake into which—so far as I can see—almost every one falls, is made of giving the opening lines of the familiar Christmas Carol thus—

> God rest you, merry gentlemen,
> Let nothing you dismay.

The original carol said nothing about "merry gentlemen," nor anything so meaningless as "God rest you:" but expressed simply the wish—

> God rest you merry, gentlemen:

as William, in "As You Like It" (Act. v., sc. 1), says, "God rest you merry, sir," *not* "God rest you, merry sir."

"An Observer" has sent us a response to our first note on corset-wearing; unfortunately it reached us (owing to our absence from town on lecture-tour) too late for this number. It shall appear next week. "An Observer," like ourselves, is seeking to inculcate what is best, and though we do not agree with his conclusion, much that he notes in the course of his skilful advocacy of a—well, a difficult cause, is well worth noting.

The objects of the Rational Dress Society (President, Viscountess Harberton) are to promote the adoption, according to individual taste and convenience, of a style of dress based upon considerations of health, comfort, and beauty, and to deprecate constant changes of fashion, which cannot be recommended on any of these grounds. An annual subscription of 2s. 6d. constitutes membership. Hon. secretary, Mrs. E. M. King, 34, Cornwall-road, Bayswater.

Very misleading statements have been pretty generally made by newspaper writers and others as to the danger incurred by those "fairies" at the Savoy Theatre who are nightly electrically illuminated; and their ignorance on such matters is manifested by the assertion, amongst others, that the lamp on each fairy's head is supplied with electricity from an accumulator. Such an idea is simply ridiculous. As a matter of fact, each of these Savoy sylphs is supplied with electricity (generated as required, and not stored) by means of three specially-constructed Planté batteries enclosed in a gutta-percha case. The whole apparatus, which weighs less than three pounds, is worn after the manner of a soldier's knapsack, and is connected with the lamp by a flexible double wire. This arrangement is the joint production of the Swan and Siemens companies, but at present capable of much improvement in the matters of weight and the number of cells employed. A switch is placed on the top of the battery by means of which the current may be turned off at pleasure; and the light produced is equal to that of six candles. From this it will be seen that the wearer of the lamp runs no risk. There is no current capable of giving a severe shock, and practically there is no more danger from contact with the conducting wires than there is in walking under an ordinary telegraph wire. The statements we have referred to are amongst the least extravagant that have been made on this subject. It seems there was a notion that these "fairies" were lighted by a wire from the main dynamo machine which illuminates the entire building.—*St. James's Gazette.*

Answers to Correspondents are, as soon as possible, to be permanently restricted to a column in length.

A NATURALIST'S YEAR.

By Grant Allen.

II.—ANTS AND APHIDES.

ON the path here an irregular procession of ants is making its way in two opposite streams, to-and-fro between the green grass-plot and the hummocky nest under the big elm tree. At first sight, the double current of little black beasts seems to obey no common law and to effect no common purpose. The ants cross and recross aimlessly from side to side, question one another in a meaningless fashion with their antennæ, and appear to find the width of the road a far greater difficulty for their dim sight than even its length. And yet if you watch them closely you will find that there is really a method in their apparently inane manœuvres; that the outward-bound messengers are making definitely, if tortuously, for certain fixed points on the grass-plot, and that the homeward-bound each carry in their mouths a small, round, greyish body. The fact is, they are taking home the eggs of aphides, or ant-cows, as they have graphically been called; and these eggs they will keep through the winter under ground, and will replace carefully in spring on their proper food-plants, so as to secure a fresh supply of their little cattle as soon as the warm season comes round again. This wonderful bit of provident care for the future, first distinctly proved by Sir John Lubbock, forms quite the high water-mark of intelligence and foresight in the insect world.

Aphides, as everybody knows, are those little green or brown flies (wingless in their commonest condition) which cover rose-bushes and many other plants, and which are familiarly, though very inaccurately, described in everyday language as *blight*. By descent they are very degenerate winged insects, but, having taken to an extremely simple and half-parasitical life, they have become exceedingly degraded in structure and functions, as almost always happens with sessile and parasitic creatures. It would take too long to go into the full history of these odd little insects, one of the prettiest and most effective objects one can look at under a low power of the microscope; but one may just say that the young aphis, as soon as it is hatched or born (for several generations are produced a-sexually without eggs during the course of a single summer), fastens itself upon the tissues of the food-plant where it first comes into being, sucks its juice uninterruptedly as long as it lives, and seldom moves at all from the place where it begins its monotonous existence. Though it has legs, it hardly ever uses them; and indeed, its whole organisation shows at once that it descends from more active ancestors, whose form it partly inherits, without inheriting their corresponding locomotive habits. Towards the close of each season, however, a generation of male and female aphides is developed from the imperfect types; and these complete forms produce eggs, which start the whole life-cycle of the race afresh at the beginning of the next summer. It is such eggs that the ants are now carrying in their mouths to the shelter of their subterranean home, in order to keep them safely through the winter, exactly as the Icelander keeps his sheep and cattle during the long, dark nights of the sub-arctic region.

But what is the good of the aphides to the ants? Do they eat them bodily, as we eat pigs and oxen; or do they keep them for some subsidiary purpose, as we keep cows and fowls for their milk and eggs? Well, if you look on a summer's day at a bit of dock covered with these tiny green insects, you will be pretty sure to see several ants prowling about in and amongst their groups, on food intent; and if you carry a small platyscopic pocket-lens (which every observer of nature ought to do) you will soon find out what they are after. Presently one of the ants will come upon an aphis which it seems to recognise as in good milking condition. At once it will run up to it, gently stroke the abdomen with its antennæ, and wait a second for the result. Then the aphis will lift up its abdomen, and quickly excrete a small drop of viscid fluid, which the ant proceeds greedily to devour. The viscid fluid is honey-dew, and I am credibly informed by stronger-minded persons who have made the experiment (which I will candidly confess I shrink from doing myself) that it is extremely sweet and pleasant to the taste. It is for the sake of this honey-dew that the ants keep the aphides; and so useful do they find these little cattle, that they not only preserve their eggs through the winter, but also actually build cow-houses over some of them, to preserve them as their own property.

Now, how can this curious instinct have been acquired upon both sides? That the habit is really instinctive seems certain, because, as Mr. Darwin points out, even very young aphides will yield up their honey-dew readily to an ant when stroked by its antennæ, but will not yield it up when similarly stroked by the hand of man with a piece of hair. This shows that the habit has become organically ingrained in the race—no antennæ no honey-dew. It also seems to me to show that the practice of yielding honey-dew has been developed by direct interaction between the ants and the aphides. It is not merely a case of the honey-dew being there and the ants coming to eat it, as is the fact with man and the potato, or man and the cow; for in those instances there is no mark of interdependence. The potato is not specially adapted for being eaten, nor the cow for being milked; but the aphis shows by its actions that it derives advantage from the ants, as the ants do from the aphides. When we find a flower and a bee correlated to one another's structure we know that while the flower feeds the bee the bee also fertilises the flower. If there were not a mutual benefit, natural selection could never have produced the mutual adaptation. For not only must the bee survive, but the flower must survive too. So with the aphides; the ant must do them some kind of good, or else they would never have become congenitally adapted to producing a sweet fluid on his behalf. Mr. Darwin suggested that the mere removal of the liquid might be an advantage to the aphides; they might be glad to be relieved of the useless excretion. It does not seem to me, however, that this explanation is quite satisfactory. We can hardly regard so sweet and nutritious a fluid as a simple waste product: it is rather, like milk, a special secretion than in the true sense an excretion. So far as I know, no animal ever gets rid of useful food-stuffs in any considerable quantities, except to feed its young, or for some other object tending to the preservation of the species. It seems more probable, therefore, that the aphides have acquired the habit of producing honey-dew on purpose in order to supply the ants; and that the ants confer upon them some substantial benefits in return.

What are these benefits? Some of them, no doubt, we do not yet fully know; but others have already been made quite certain. In the first place, there is this very storing of the eggs during the winter, so as to replace them on the proper food-stuffs in spring. That is a distinct and decided advantage to those species of aphides on which it is performed. Then again, there is the covering up of the colonies in little cow-houses, which serves to protect the aphides from the intrusion of unwelcome guests. Once more, it is well known that ants act as effective guardians

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over certain plants in which they possess a proprietary interest, and amongst others over those which form the proper pasture-grounds of the aphides. Every botanist knows that the interaction between plants and ants is minute and intricate to the most marvellous degree. Some plants attract the ants by nectaries and sweet secretions, to protect them from caterpillars and similar foes; other plants ward them off by hairs, moats, *chevaux de frise*, and like barriers or fortifications, from stealing the honey in their open flowers. It is easy enough to understand, therefore, that the aphides may, in the same way, have acquired the habit of excreting honey-dew under the influence of natural selection, working through the persons of the ants; because those which possessed these sweet secretions would thus gain protection for themselves, their eggs, or their food-plants, while those which did not possess them would be left to the tender mercies of an unsympathetic and hungry world. Just as the horse, the cow, and the dog, have survived the extinction of the other large mammals in Europe by their usefulness to men, so certain aphides have survived the remainder of their kin by their usefulness to the practical-minded ant. This was all the more easy for them to effect, since their whole life is passed in merely sucking juices from the plant which they infest, and they can thus easily afford to spare a little sugar from the abundance of their food-supply, in order to strike a league of permanent friendship with so active and intelligent a force as that of the provident, locomotive, warlike ants.

LEARNING LANGUAGES.

By Richard A. Proctor.

(*Continued from page* 427.)

THE plan by which I learned enough of Latin and Greek to read most books in these languages with tolerable ease, was an anticipation in some degree of the Hamiltonian method, and may be useful to those who find a difficulty in getting books (now out of print) written specially in illustration of that method.

As I have said, I learned Latin and Greek in the usual way at school and college. I gave to them on the scholastic system much more time than I ever did on my own plan; yet I may almost set on one side altogether all that I so learned about those two languages. I should have learned the declensions and conjugations and the elementary rules readily enough (after picking up the general idea of each language) from a few hours' study later on, with much more satisfaction, and, therefore, much more easily than I learned them at school, when as yet I had very little use for them. As for the rules, every schoolboy of the old Eton Latin Grammar days, knows that for any good the *Proprja quæ maribus* did him, in learning what may be called the philosophy of Latin, he might as well have been learning Hindoo. He was much more particular to learn the sequence of words than to think of their meaning. I am not sure that a boy has learned very much when he even knows as a fact that you may term masculine those proper names which belong to males; but I know that ninety-nine schoolboys out of a hundred (probably the hundredth too) pay no attention to this fact, important or otherwise, and limit their attention entirely to the words. To this day I can repeat rules from the Eton Latin grammar, the meaning of which is altogether new to me, for the simple reason that I learned and have retained the words and have till now never thought of the meaning. I feel tolerably sure that if any one had asked me suddenly when I was a boy to tell him about those four gods mentioned in my Latin rules—"you know the four I mean, my boy; let me see — m-m-m — Mars, Bacchus, Apollo, Virorum; tell us about Virorum,"—though I should have seen the joke, of course, it would yet have occurred to me as quite a novel thought that the words I had so glibly by rote, had a meaning, though a useless one for me at the time. I know, and any one who likes to try the experiment with his own boys will find it so, that such rules as I quoted in my last are learned simply by rote. Ask a boy, even a bright one (at the head of his class), what is meant by a deponent verb, not letting him merely quote his grammar definition, but asking him what it means, and the chances are ten thousand to one that he knows nothing whatever about it. The chances are a good deal more than ten to one that the first educated person you meet—the reader of these lines, perhaps—can tell you nothing to the purpose about a deponent verb (why it is called deponent, for instance); and I doubt if one in ten thousand needs to know or wants to know anything on the subject. It is not because our school teaching fails to give boys clear ideas about such things that I object to the system; but because the boy has no use or occasion for any knowledge on such subjects. Teach him the language, and very likely, later on, he may, if philologically inclined, find great pleasure in studying the philosophy of it; but don't waste time teaching him what he does not understand, and what would be utterly useless to him if he did. Make him feel how well worth while it is for him to be able to read Latin and Greek, by teaching him to read pleasant and instructive books in those languages. Make him feel that he is getting on—that, as week after week passes, he reads his Latin and Greek more easily. Show him the peculiarities of structure where doing so will help to make his reading come easy to him. If he shows interest in such matters, tell him (but don't make him learn by rote) about these peculiarities and their significance. But above all, make the task of learning the language as easy as possible to him; make it a pleasure to him, if he is a bright boy—make it as little as possible of a burden to him if he is a dull one. Reward rather him who tries to understand and make progress, than the boy who only cares to learn by rote what he may find in his books.

I learned almost all I know of Latin and Greek away from school and college, using that abomination to the scholastic mind—literal translations. I would read page after page of Latin—Cæsar, Cicero, Virgil, the "Satires" and "Ars Poetica" of Horace; in Greek—Herodotus, Xenophon, Homer, and the like (meaning of like simplicity of construction, eschewing for the time the more difficult writers, as Tacitus in Latin and Thucydides in Greek), with the translations ready for constant use. "The translations are abominable": granted, it is their great merit. Any one who has the least power of appreciating language, feels that he *must*, as quickly as possible, learn to do without their aid. But in the meantime they save the dreary, time-wasting work of turning over dictionaries and lexicons and grammars by giving at once the proper equivalent of each word and the right meaning (however badly expressed) of each sentence. "But this is an exceedingly lazy way of learning," says the schoolmaster. Awfully lazy, if you take only your thirty or forty lines; but quite the other way if you take ten or twenty pages. "The memory is not sufficiently exerted." Certainly it is not, if the learner is content to leave it unused; but if, after reading ten or twenty pages in this way, he reads them over again in the original, once and again, until, without the translation, he can follow the whole passage as Virgil or Homer wrote it, his memory will be sufficiently exerted.

He will have learned something too besides the meaning of so much Latin or Greek; he will have read and enjoyed a noble passage (I care not where he has been reading). Can any schoolboy, or man who has been a schoolboy, and even a successful one, say truthfully that he ever enjoyed the thirty or forty lines over which he had plodded with grammar and dictionary?

But as this sort of work continues, the student finds that the language itself has an interest for him. He feels that it is worth while to learn something about the grammar and structure of the language,—not the absurd things taught in schoolbooks, or not in the same absurd way, but intelligently. Of course, he will early have learned the rules for declining and conjugating—not feebly getting up declensions and conjugations by rote—but noting how the different forms of declensions and conjugations compare with each other, and with those in his own language, where such forms exist. This should at first be rather reading up than learning. Then the rules of syntax come to be considered. The schoolboy gains nothing by learning syntax rules by rote, whether they are like or unlike those in his own language; but one who has noticed or been told that as in English, so in Latin, the verb must agree in number and person with its nominative, or that the same holds in Greek except in the case of neuter plurals, has learned what is useful and interesting to him; while he is equally interested when he notes divergencies, as for instance the way in which particular cases are "ruled" in Latin or in Greek. The more he reads in either language, the readier he will be to note, and noting, to be interested by, the rules of grammar and construction. Of course, if he wants to *write* Latin or Greek, he must pay more particular attention to such matters; but not one man in ten thousand wants to write in a dead language—except to obtain marks in a competitive examination, and I am not writing for these (they must work according to the conditions of such examinations, conditions devised by those who have devised the utterly ineffective and time-wasting methods I have dealt with).

We come next to the Hamiltonian method.

(*To be continued.*)

The Electric Light.—A list of towns for which application to the Board of Trade for Provisional Orders empowering the applicants to provide electric light installations, has been prepared by the manager of the South-Eastern Brush Electric Light Company; 152 applications have been made, of which 51 are by the various Brush companies, 38 by other companies, and 63 by local authorities.

"The heart is a wonderful piece of mechanism," says Dr. Kronecker, "not merely because of the great force which it displays, or on account of the very perfect system of valves that it possesses, but also because it is able to go to work almost instantly as soon as it is fed, and because it utilises to the fullest extent, in the most economical manner, the force at its disposal. As soon as the liquid that it is expected to pump is withdrawn, it stops work entirely, and does not consume itself doing useless work, but keeps in good condition for a long time. When the heart works, it always works with its full strength and with suitable velocity; it is not at all affected by changes in the amount of stimulation it receives, and this is essential to its power of moving comparatively heavy burdens with constant uniformity. Under conditions that hasten the decomposition of food (such as heat), the mobility of its parts increases; under external conditions which retard the change (as cold), it moves more slowly."

THE CORSET AS AN AID TO BEAUTY.

By Richard A. Proctor.

(*Continued from page* 430.)

I APPROACH a difficult question, though not a doubtful one. Who shall by argument depose false tastes? And who can deny what "An Observer" has told us, that the recognition of something beautiful (Heaven knows what) in a pinched waist, has prevailed very widely and very long? "'Tis true 'tis pity; pity 'tis 'tis true." There can be no manner of doubt as to the just proportions (with a certain limited range of variation) of the human frame, masculine or feminine. Not Art has settled that, though Art assents, but Nature. I do not say that when wild in woods the noble (but generally beastly) savage runs, he or his "squaw," or "gin," or whatever he pleases to call the woman of his race, presents the perfect type of human beauty. The savage manner of life prevents this, save in a few very exceptional cases. Your average savage is apt to be lank and ill-shaped—especially about the calves; his body is as coarse in type as his face. Still, even among savages of certain races the typical form of human beauty is occasionally approached. You see the man with well-knit and fully-developed muscles, moderately-sized hands and feet, narrow flanks, chest deep and broad, the surface of the abdomen nearly straight from the chest downwards, but with that slightly greater curve from side to side (leaving depressions along either side of it) which the corset ruthlessly squeezes into the ridiculous circular waist of the stayed ones. Savage women, even of the families of the chiefs, are usually, for at least the greater part of their lives, still less shapely than their generally brutal lords (so astoundingly remote—are they not?—from any of the animals to which Darwin says they are akin). Treated in many cases as cattle, they do not develop into the graceful, lissome forms which the artist admires. Yet, even in their case, among some races and in special instances, we find the artistic idea of feminine beauty approached during the short—usually the very short—time that the women of savage races are in fully developed womanhood, but as yet not mothers of baby savages.

But it is not among savages, any more than it is among highly-civilised races, that we must look for beautiful and shapely forms;—observe, *not* for ideal beauty, which is not what we are inquiring about, but for those proportions which are developed in the healthiest, and strongest, and best representatives of a race, under the most favourable conditions, and during the stage of life at which the kind of beauty we are considering can alone be looked for; from early youth (boyhood past) to the prime of manhood in men; from the end of girlhood to a few years only beyond the time of first motherhood in women. There is an intermediate stage in the development of a race as there is in the lifetime of each member of the race, when the greatest physical beauty and grace are attained. This stage is that period of early civilisation, when as yet the natural has not been wholly absorbed in the artificial. Taking that stage of the development of the race which stands first for beauty of form as well as feature—the ancient Greek race—we find the type which the greatest sculptors the world has known—Greek, Roman, and modern—have delighted to represent. The Greeks in particular selected as their models (though not in our modern sense) men and women, youths and maidens, whose beauty of form was the result of adequate exercise (with little encumbrance of clothing), modelling forms belonging already to the best types. They show us, first, what Nature has selected as shapeliest, and next what the

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The Apollo Belvidere.

The Diana of the Louvre.

artistic mind at the time when art was at its highest approved as most beautiful. That the proportions of the human body (naturally developed) in other races, or even in the present descendants of the Greek race, may be somewhat different, and still be beautiful, may be admitted. That Phidias and Praxiteles, if they lived now, still possessing all that observation had taught them in their own time, but with the power of comparing therewith other forms than those they studied, might slightly modify their views as to the most perfect types of manly and womanly beauty, may readily be granted. There is a range of variation within which perfect ideal beauty exists. (I do not use the word *perfect* carelessly, but mean it in its full sense. For, as there is no law of beauty which assigns a certain exact number of inches in height to man or woman, so is there none which assigns exact relative dimensions to trunk and limbs.) We may even go a little further, and admit that a sculptor of the palmiest days of Greek art might be ready to acknowledge, *now*, that some of his conceptions of ideal beauty admitted of improvement—that, for instance, an Apollo or a Venus of his (a Phœbus or an Aphrodite, I should say), might have gained in delicacy and beauty had her hands and feet, wrists and ankles, been slightly smaller in proportion. He would have ridiculed, doubtless, the idea that the smaller the hands or the feet, the more beautiful they are; and he would certainly have recognised in the very smallness of the hands and feet of many beautiful women of our western races (especially in America) a defect instead of an excellence; still, he might have admitted that without appreciating these artistically imperfect forms (no more beautiful than a wizened arm is beautiful) the goddess of Melos, and the fair statues of Aphrodite, Artemis, Hebe, Phœbus, and so forth, might have had rather smaller hands and feet with gain rather than loss of beauty. He might even have admitted, though I think it doubtful, that waists somewhat smaller than those regarded as most beautiful in his day, might be as shapely, at least for certain types of masculine or of feminine beauty.

But these are questions of proportion, and even these changes or varieties can only be considered by an artist as admissible within certain limits. If a Greek or Roman sculptor had been asked to take two such forms—masculine or feminine—as are shown in the Apollo Belvidere and the Diana of the Louvre, and without altering other dimensions, to modify the waist measurement, so as to correspond to what many women and a few men try to attain

by the use of corsets, he would have judged the task hopeless. With all his skill he could not have given beauty to a nude Aphrodite, representing a woman 5 ft. 4 in. in height and 18 in. round the waist. He might have made a quaintly effective statue, but it would have been in his eyes only a Grotesque.

Yet that would be a mere nothing to the attempt to model a statue from a corset-marred woman of the height and waist measurement just mentioned. The ancient sculptor's work, though grotesque, would represent a human being as Nature might fashion one, who does not give to all animals perfection of proportion. The corset-spoiled waist does not err in being out of proportion, but in being deformed. It is not merely the ellipticity of the natural waist that is wanting, but all the curves which a well-shaped waist possesses. A perfectly-formed waist, of man or woman—as for instance, the waist shown in

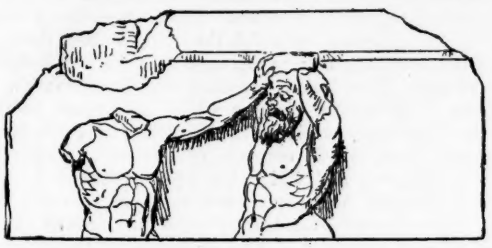

Fig. 1.

Fig. 1 (not the centaur's), and the waist of the Apollo Belvidere (which is, however, somewhat feminine in type) may be compared to perfect music, so beautifully are its proportions harmonised; a grotesque waist, such as I imagined above, might give pleasure like a quaint and fanciful air; but a corset-made waist is sheer discord to the artistic mind. Like the crushed foot of the Chinese lady, the compressed head of the savage, pierced lips and nostrils (aye, and pierced ears, too, fair ladies), the waist made by stays is not ill-proportioned, it is malformed. Yet even the waist thus distorted—the waist made by stays—is not so hideous as the waist when actually in its corset enclosure. For enfeebled though the stays-pinched woman is about the waist, she can still bend her waist a little when the stays are removed. The movement is of course ungraceful; there are no gentle curvings and undulations, as when an undeformed woman bends her shapely waist; but still there is a possibility of bending. With a well-tautened corset there is none; when the waist moves it moves all in one piece. The wearer may walk or even run (at her proper peril), or dance, or ride; the trunk, as a whole, may move in a variety of ways, just as the arm may, if you put it in splints; but there is no more possibility of curving the trunk between the hips and the chest than there is of bending an arm at the elbow when it is in splints from shoulder to wrist. Yet Nature probably did not provide abdominal and lumbar muscles for nothing, any more than she fashioned elbow and knee joints to no purpose.

(*To be continued.*)

New Company.—The prospectus of the Patent Electric Gas Igniting Company (Limited) has been issued. The Company proposes to light gas by means of a spark from an induction coil. This is comparatively a very ancient idea, and for some application of it the Company is to pay a sum of £75,000, £29,920 in cash and £45,080 in shares, the total capital being £100,000. We refrain from commenting on a scheme which looks for a large profit on so small an available capital.

THE GREAT SUN-SPOT.

We give the accompanying for comparison with our less satisfactory view, see page 431.

Great Sun-spot, Nov. 19, 12.

(J. W. Ward, Belfast, 4·3 in. Wray equatorial, Hugh^{s}., power 113. Hodgson prism single surface reflection used.)

The spot at this time was decidedly of a *cyclonic* appearance, a huge forked tongue lying *spirally* over the umbra, and all round the larger spot there were shelving "tongues" distinctly seen projected into the blacker umbra.

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

No. I.—BONES.

By Dr. Andrew Wilson, F.R.S.E.

If there is any one part of the human frame which more than another appears to be dead and lifeless in its character, that part is the skeleton. We are apt to translate our ideas of what a *living* bone should be, from that which a *dead* bone is—hard, firm, dense, unyielding, and, above all, lifeless, material. Now this is very far indeed from the true state of matters. The physiologist tells us that bone is not merely a thoroughly living tissue, but that it is literally living in all its parts. Furthermore, a little reflection will teach us that as bones have to grow, they must needs do so by processes similar to those through which other parts of the human frame increase. If we cut a bone it bleeds; and this fact alone shows us how plentifully bone is supplied with blood-vessels, carrying the nutrient fluid for its repair and growth. Again, there was a period in our individual history when bone was not. Bone must, therefore, have been formed as other tissues grow, and must have exhibited all that vitality which marks the production and development of the varied belongings of our frames.

Let us suppose that we cut across a long bone, such as the thigh bone, or any bone of the arm itself. In the hollow interior of the bone, we find *marrow* when the bone is examined in the fresh condition. The bone itself is very dense and thick towards the outside layer, but of more open structure as we approach the inner layers. Outside the bone, and adhering very closely to it, is a tough layer known as the *periosteum*. There is no doubt that this layer has much to do with the repair of bones when they are broken or injured, and, for one thing, it supports the bloodvessels which enter the bone and which nourish it.

To properly understand what bone is, we must appeal to the microscope. A thin cross-section of bone, ground down till it becomes so transparent that we can reflect the light through it, is placed under the object-glass of the microscope. Regarding this view of bone attentively, we

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see the following things: firstly, a number of round spaces. These are the ends of tubes or canals cut across. They are named *Haversian canals* (after Clopton Havers, their discoverer), and in the living state contain the larger blood-vessels of the bone. Secondly, around these *Haversian canals* we note a series of irregularly-shaped spaces

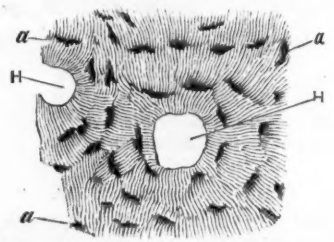


Fig. A.—A transverse section of bone in the neighbourhood of two Haversian canals, *H, H; a* lacunæ. Magnified about 250 diameters.

arranged in concentric circles. These spaces are called *lacunæ*. Thirdly, leading from one *lacuna* to another, and also connecting the *lacunæ* with the Haversian canals, are a number of fine lines, which are, in reality, channels.

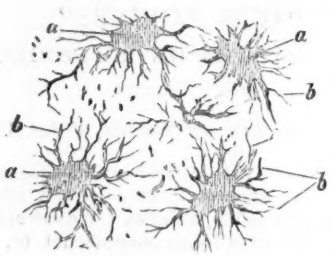


Fig. B.—Lacunæ, *a*, and canaliculi, *b*. Magnified about 600 diameters.

These are called *canaliculi*. The *lacunæ* measure about the eighteen-hundredth part of an inch in length, and the *canaliculi* a fifteen-thousandth of an inch in diameter. If we imagine the *lacunæ* to be a series of lakes, the *canaliculi* will represent small rivers which connect the lake-systems. Between the lakes and their rivulets is the mineral substance of the bone, chiefly consisting of *phosphate of lime*. Now, what, it may be asked, do the *lacunæ* and *canaliculi* contain in a living bone? The Haversian canals we have seen to protect the bloodvessels which nourish the bone. The *lacunæ* contain each a small mass of living *protoplasm*—the universal matter of life—forming the *bone-cell*. From each bone-cell, lodged in its *lacuna*, there passes along the *canaliculi* fine threads or processes of this jelly-like protoplasm. Thus the protoplasm of one *lacuna* is brought into connection with that of the other spaces; and the whole living substance of the bone forms a continuous meshwork of minute cells and fine fibres. Little wonder is it that, thus filled with living material, bone should demand a rich supply of nourishment in the shape of blood.

Bone, when analysed, is found to consist of an *animal* part and a mineral part. The animal part consists chiefly of *gelatine*. The mineral part is largely *phosphate of lime*, or "bone earth," with a little *chalk* (*carbonate of lime*) and other minerals. We learn from this fact how important for the young and growing body it must be to obtain in the food a due supply of bone-forming materials. From bread, porridge, water, and like foods we obtain the minerals necessary for bone-growth. Rickety children have bones in which the process of nourishment has not been duly carried out, and hence arises the deformities to which these children are so liable. In early life the bones contain a larger proportion of animal matter than in old age, when they become brittle and easily broken from excess of the mineral constituents. If we soak a bone in a weak acid, the acid removes the mineral part, and leaves the animal part untouched, the bone retaining its shape, but becoming lithe and flexible.

"How and from what is bone developed?" is a question of much interest. The *long* bones of our bodies are "laid down," so to speak, in *gristle* or *cartilage* as their foundation. The *flat* bones, such as those of the skull, are formed from *fibrous membrane*. Cartilage, which is the *matrix* or "mother-tissue" of long bones, consists essentially of minute cells, set in a structureless layer. Where bone is to be formed, these cells arrange themselves in long, parallel rows, and multiply rapidly in numbers. Then comes the process of *calcification*, or that by which the living matter, derived from the blood, is thrown in amongst the cells, and invades the cartilage. Thus lime is provided for the formation of the bone. The further changes which take place in the growth of the bone, consist in the formation of a thin layer of spongy bone, which consists of *bone-cells* containing living protoplasm, and which has been produced by the under surface of the *periosteum*, or layer covering the bone. These bone-cells in turn develop lime around themselves, so that naturally, a ring or circle of these bone-cells will form a layer of bone, embedded in which we find the living protoplasm in spaces which will become the *lacunæ* of the full-grown bone. The spaces in the centre of the circles of bone-cells will become in like manner the *Haversian canals* of the adult bone. Meanwhile, outside the bone, the *periosteum* continues its work of bone-formation, the thickness of the bone being thus ensured and increased; whilst later on, the *lacunæ* or spaces which are set widely apart in the young bone appear more closely set, owing to the growth which fills up the interspaces, and which adds to the solidity of the structure.

Bones begin to grow usually at several points in their substances. These points are the "ossifying centres." For instance, a long bone, like the thigh bone, begins existence as a mere rod of gristle, and ends it as a dense solid bone: its growth having taken place from three "centres"—one in the shaft or column of the bone, and one for each end thereof. When it grows in length, the increase takes place at each end of the shaft; for if two pins be placed a little way apart in a growing bone, the distance between them does not increase, whilst the bone itself extends in length. Removal of the end of a growing bone destroys its further increase.

Lastly, we should note how the whole process of bone-growth is one dependent on the living protoplasm of which the *bone-cells* are composed. Later on, we shall see how the entire life of man—and necessarily that of other animals—may be truly described as the cumulative result of the growth and work of these minute living structures. And no more wonderful thought can be impressed on the mind than that which shows us that, after all, human life, as we know it, represents merely the activity of those minute units which only the higher powers of the microscope reveal to our understanding.

Telephone Wires in Birmingham.—The Telephone Company in Birmingham are negotiating with the Corporation for the laying of some of their lines underground. The work will be begun by placing underground the wires now crossing Stephenson-place.

VENUS IN TRANSIT.

IT has been noticed that when nearly the whole of the disc of Venus is in the sun's face, the part of her outline which is still outside the sun is surrounded by a fine thread-like arc of light—light so bright that it is manifestly not merely reflected sunlight, but sunlight itself. It is so bright that in the mere instant of time during which the photographic plate is exposed in taking solar photographs this arc of light not only had time to record itself, but even to record itself with an obvious increase of width due to over-exposure. It was then sunlight brought into view round the convexity of Venus's globe by the bending power of the planet's atmosphere. This observation is well worth repeating, and that fine arc of light is well worth studying with the spectroscope, for such a thread-like line of light would tell the story of the atmosphere through which it had passed in a most effective fashion. No slit would be required for the sifting of the solar rays, seeing that the line of light must be as fine as the finest slit would make it. Its breadth is, in fact, no other than that of the atmosphere of Venus, seen at a distance of some twenty-six millions of miles, and the part of that atmosphere effective in bending the sun's rays cannot be deeper than twenty or thirty miles, a thickness which at that enormous distance is practically evanescent. The other peculiarity, which is worthy of careful study, is the ring of light seen round Venus when she is on the disc of sun. It is commonly stated that this ring of light is brighter than the background—the solar photosphere—on which it is seen; but this, it need hardly be said, is absolutely impossible. Mr. Brett, the artist whose imagination enclosed Venus in a glass envelope, showed how, in his opinion, the brightness of sunlight, coming through the vitreous atmosphere, might be strengthened by internal reflection, and so forth, until it was brighter than its source. But although this idea is of course utterly inconsistent with optical laws, about which, unfortunately, many excellent painters know very little, the seeming brightness of this arc of light is very well worth studying. It is an optical illusion, no doubt, but an optical illusion often leads the way to the knowledge of a very real physical law. Moreover, by interpreting optical illusions, we learn how, in future, illusions of the same sort may be prevented from misleading us.

But now it may be asked how the science of astronomy is to be benefited by that which, after all, must be regarded as the most interesting matter associated with the observations of Venus in transit—the determination of the sun's distance? Newton used to say that, so far as the law of gravitation is concerned, it matters nothing whether the sun is a hundred millions of miles away, or a thousand millions, or only one million. All the movements within the solar system would take place in just the same manner whether the sun were near or far off, or rather (for that is the real question at issue) whatever the dimensions of the solar system. Precisely as a clock's hands may be shortened or lengthened, and yet show time as well as before, so our ideas as to the dimensions of the solar system may vary without the slightest change in our ideas as to the movements within the system, or as to the law on which those movements depend. All this is true so far as mere motion is concerned—the kinetics of the solar system would not be changed in the least by a change doubling or halving our estimate of the sun's distance. But it is different with the physics of the solar system. Any change in our estimate of the sun's distance involves a change in our estimate of his physical power, his might as ruler of the solar system, his capacity as the source of all the supplies of light and heat by which it is nourished, the time during which these forms of energy can be supplied, the scale on which those mighty processes take place, whose existence we infer from spots and faculæ, cyclonic storms, eruptive prominences, and even, in all probability, in the changes affecting the solar corona itself.—*Standard.*

EARTHQUAKES IN HEREFORDSHIRE.

By T. W. Webb.

MAY I beg permission to add a few particulars to your truly remarkable account of the earthquake felt in Herefordshire in the early morning of Oct. 6, 1863. My parish of Hardwick lies between the upper end of the Golden Valley, to which you have referred, and the town of Hay, and many of us heard the roar and felt the concussion with the greatest distinctness. One cottager compared its approach to the sound of a carriage rolling over boards, and when it came up it rattled the tiles on the roof progressively, as far as I recollect, from one end to the other, which, if his impression was correct, would bring it from the west. Feeling a great interest in such phenomena, and never having witnessed one, I thought myself very unfortunate on the occasion. During the first half of the night I had been examining nebulæ and other faint objects with my 5½-inch object-glass, and with some success. I had made out for the first time the longer of Bond's canals in the great Andromeda nebulæ, and had readily detected the nebula in the Pleiades, and had perceived Otto Struve's Pons Schröteri in the nebula of Orion. The increase, however, of moonlight and cold induced me to discontinue my employment a short time—perhaps three-quarters of an hour—before the arrival of the shock, which I should otherwise have had such an admirable opportunity of observing. As it was, I was partially roused from my first sleep by a concussion which rattled violently the doors of a locked wardrobe, and probably the pictures on the walls, but passed away leaving me too drowsy to think of anything more than a furious gust of wind, which I had forgotten on awaking next morning. The servants, however, felt their beds lifted up. The only remaining evidence in my house was the throwing on the ground of a small unframed picture that stood upright against a wall; but the chimney of an old cottage about a mile distant was believed to have been cracked at that time. But I think it was more extensive than is intimated in the account you have given. It was felt at Liverpool, and announced the previous evening, unless my memory deceives me, by the singular movements of some linen hanging on a line. At Cheltenham, where my wife was then staying, its effects were not less marked than in the distant valley of the Wye and Monnow. It awoke her roughly from sleep; the sound, as she described it, resembled that of great rocks falling one over another into a deep chasm; everything in the room was shaken; the Venetian blinds quivered; and the night-light was extinguished. Several persons were made ill. One of them, a respectable tradesman, described the sensation as that of being heaved up from beneath in bed, and having a light in the room he saw the books on a partially-filled shelf tilted from side to side. A baby was rolled out of its cot; and a policeman stated that he could see the undulation of the houses in the moonlight, and was obliged to steady himself by holding on to a lamp-post.

Since that time we have felt two distinct shocks at my house, though of less severity. In the former instance a little dog leaped in terror from a lady's lap, though none of

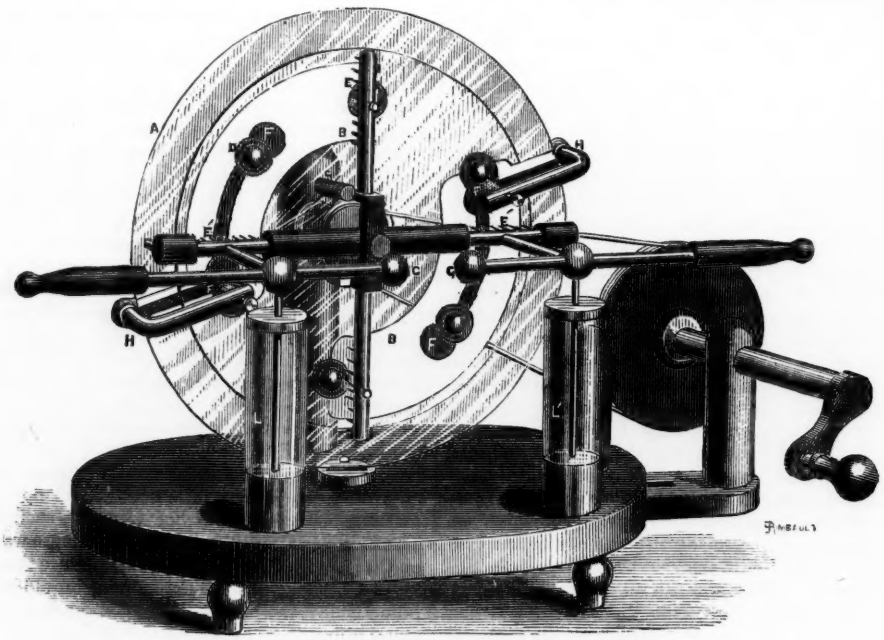
the party in the room felt any shock, and the sound was ascribed to a passing vehicle; a candlestick, however, was jarred on the kitchen-table. In the other case the sound, which was like that of a train some miles away, was supposed by me to be distant thunder, till it seemed to reach the room where I was, and gave a snap to a very hard window-fastening, which at once convinced me of the nature of the occurrence, though I was taken too much by surprise to notice what shock there might have been; it was felt, however, by my wife in another room; and I noticed how the pheasants in the woods immediately began to crow in terror.

I have many times felt slight tremors and jarrings, especially in bed, which I think were not illusory, and which lead me to suppose, independently of the curious experiments of M. d'Abbadie and others, that the surface of the earth is less stable than we are apt to imagine.

The earthquake in the time of Queen Elizabeth (1580) caused so much alarm that a special Form of Prayer was prepared on the occasion, and a "Report" of it seems to have been put forth by authority, both of which may be found in Clay's "Elizabethan Liturgies," a work to which I have not at present access.

THE VOSS INDUCTION MACHINE.

THE hold which telephony, electric lighting, and such-like applications of electricity have made upon the public mind during the past three or four years is so unduly great, that progress in other branches of the science has little prospect of receiving a fair share of attention. The Voss machine is in this unfavourable position, for, while it is one of the greatest improvements of the day, it has not until recently met with that attention to which it is so justly entitled. It is represented in the accompanying illustration, from which it will be seen that the apparatus consists, like the Holtz machine, of two glass discs, unequal in diameter, of which the larger, A, is held in a fixed position, while the other is mounted upon a horizontal axis, and can, by means of multiplying gear (seen to the right of the figure) be rotated at a high velocity in front of the fixed disc and in a plane parallel to it. To the back face of the larger plate are attached two pairs of tinfoil discs, F F, F F, each pair being connected together by a strip of tinfoil, and by a second strip to one of the two bent arms H and H, by which they are connected to a light metallic brush directed towards the front face of the rotating plate. Over the tinfoil are pasted two paper coatings, which correspond to what used to be called the paper "armatures" in the Holtz machines. To the face of the rotating plate are attached, at equal angular distances apart of 60 deg., and at a short distance from the circumference, six discs of tinfoil (one of which is marked D in the figure), about an inch in diameter, corresponding in position and size with the tinfoil discs upon the fixed plate—that is to say, if the discs (D) were numbered in rotation, 1, 2, 3, 4, 5, and 6, those numbered 1 and 2 would, in a certain position of the rotating plate, correspond and be opposite to one connected pair of discs on the fixed plate. Nos. 4 and 5 would similarly correspond to the other pair, and Nos. 3 and 6 would have no discs on the fixed plate opposite to them. To each of the little tinfoil discs on the rotating plate is attached a metallic button of the form of a plano-convex lens, and these buttons, in the revolution of the plate, pass under and are lightly touched by the metallic brushes (F F), which are held by the bent arms (H H), the brushes being so adjusted as only to touch the buttons, and not to come in contact with the glass of the rotating plate to which they are attached. E′ and E′ are two horizontal collecting combs, insulated from one another by being attached to a horizontal bar of ebonite, but connected respectively to the two discharge terminals (C and G) in the front of the instrument by the horizontal bars



shown in the figure, and the distance between these terminals can be varied at pleasure by sliding them through the balls which are attached to the inner coatings of the two cylindrical Leyden jars by which the charge is accumulated and the discharge intensified. E is a vertical bar of brass, carrying at each end a comb, directed towards the rotating plate, as well as a pair of metallic brushes similar to F and F, and which also in their turn make momentary contact with the metallic buttons as they pass beneath them.

The machine is a step far in advance of anything previously produced, although it is somewhat similar in principle to Varley's electrostatic inductive multiplier.

A small initial charge is imparted to the machine in some as yet undetermined way. It may be due to the friction of the metallic brushes with the studs or buttons; or, on the other hand, it is possible that the various parts of the machine before starting are in slightly different electrical conditions. Whichever of these hypotheses is correct, a small charge of, we will say positive, electricity collects on one of the pairs of discs, on the fixed plate, and from this, as a nucleus, brilliant discharges may be obtained. To analyse the action of the machine, we will assume that we start with a stud, as being typical of the others, immediately after it has passed the bent arm, H, on the left, and that the corresponding side of the fixed plate has the small positive charge above referred to. As the stud passes before the charged disc, electricity is induced on it, the inner surface becoming negative, the outer receiving a positive charge, which is collected by the horizontal comb E′, and passes thence along the brass rods to the discharge terminal, C, and the inner coating of the Leyden jar, L. The stud, in revolving, undergoes further induction, and on arriving at the vertical comb, E (really not quite vertical, but opposite the end of the paper), a further withdrawal of positive electricity takes place; a considerable negative charge, therefore, remaining. This the stud carries round till it meets the brush of the bent arm on the right side of the machine. By this means, a negative charge is communicated to the pair of discs on the right half of the fixed plate, the stud at the same time becoming neutralised. It is then re-excited in an exactly opposite manner to that previously observed, negative being imparted to the horizontal comb, E′, and Leyden Jar, L′, and likewise to the lower of the two vertical combs. A positive charge is collected by the bent arm, H, on the left, thereby increasing the charge already collected on the corresponding pair of discs. This action continuing, a large charge accumulates on the fixed plate. It follows that if, by means of the electricity collected through the bent arms, we increase the inducing charges on the fixed discs, we shall obtain proportionately increased charges in the horizontal collecting-combs. Assuming that the discharging terminals (C G) are in contact, there will obviously be an almost constant flow of positive electricity in one direction and of negative in the other. If, a few seconds after the working commences, we separate the discharging terminals, a stream of sparks may be obtained. The function of the vertical combs is, as may be gathered from the above, an important one, their duty being to relieve the studs of the free electricity induced in them as they pass from the horizontal combs towards the vertical.

Very little labour is required to work the machine, owing mainly to the fact that practically none of the electricity is generated by friction, the small amount of work performed in turning the plate being almost entirely converted into induced electricity. The machine works well in any atmosphere, hot or cold, wet or dry—a very important point, considering the effect usually produced by the humidity of the air. Every lecturer or student of electrical science knows how difficult it is to generate static electricity by the ordinary frictional machine when a few persons are present in the room. As the result of considerable experience with the Voss, we can confidently say that such difficulties need never be apprehended, while a flow of sparks, 4 in. or more in length, can be relied upon from a machine weighing less than 7 lb., and with a rotating plate $10\frac{1}{4}$ in. in diameter. All the ordinary experiments of static electricity can, of course, be performed, and we are rarely able to so confidently recommend a commodity as we can the Voss machine to all who desire to perform electrical experiments with a minimum amount of trouble and at a moment's notice. The machine is comparatively a cheap one, and the English agents, Messrs. F. E. Becker & Co., of Maiden-lane, Covent-garden, are now manufacturing it in large numbers.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

"Let Knowledge grow from more to more."—Alfred Tennyson.

SATURN'S RING.

[656]—It may not be amiss to rectify a mistaken assumption of Captain Noble, in his letter printed at p. 329 of Knowledge. The "person to whom notice was sent hereof" was not Wallis, but Sir Robert Moray—first President of the Royal Society. This appears from William Balle's letter to Oldenburg, dated April 14, 1666, in which he asks whether Sir R. Moray has communicated his observation of the previous autumn.

I notice that throughout the correspondence in Knowledge the place where Balle made his observations is printed Mainhead. This is doubtless due to the mis-spelling in "Phil. Trans." It should be Mamhead. There are two letters from Balle in the archives of the Royal Society—both (as may be seen by the published "Catalogue of the MS. letters in the possession of the Royal Society") dated from Mamhead. The only instance in which the name is written "Mainhead" is on a cutting attached by sealing-wax to the fly-leaf of the first letter, but it is doubtful whether this is in Balle's writing.

It may interest your readers to know that there is a postscript at the end of Balle's letter of April 14, 1666, containing another figure of Saturn. This figure has a dotted line across the sphere indicating the shadow of the ring, but the ring itself shows no vestige of any dividing line. This observation, however, was made only with a twelve-foot glass. Herbert Rix.

Science Club, Savile-row, W.

BRAIN TROUBLES.

[657]—May I add a quota to the singular experiences of this kind? I write a good deal by fits and starts. At intervals—not very frequent—I catch myself omitting the *first letter* of some words! As far as I have casually observed, the graphical objection is at *d* and *p*. Not thrice a year, perhaps, does this happen; but, when it does occur, I have occasionally to re-write a note in

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consequence. To have to write one note on a subject is sometimes a real nuisance; but duplication of the nuisance is simply torture. My daughter, I find on inquiry, goes in for a *d* instead of a *t*. It will be interesting to ferret the cause of this. For my own part I have never thought to think about it. The brain can scarcely have to do with this calligraphic confusion. Perhaps it is general. I almost hope it is. T. A. R.

[When tired, I find myself very apt to omit the last letter of a word, if that letter occurs as a strong letter in the next; thus, if I am writing the words "he had made," to write "he ha made," invariably detecting the mistake, however, before I have finished the word following that whose last letter has been omitted. When I was a lad at school, I often wrote, in hurried work, "g" for "d," as "ang" for "and." I find myself occasionally making this mistake now, and, which rather surprises me, oftener with the typewriter than with the pen! R. A. P.]

[658]—May I add my little experience of "Brain Trouble" to those already recorded? When tired or worried, I find the most nonsensical sentences, or rather strings of words without the slightest connection, chasing each other through my brain with marvellous rapidity and persistence. The combination of words and ideas are so ridiculous I often wish to remember some of them, but they are gone as rapidly as they come. At first it used to distress me, but now it rather amuses me to (as it were) listen to the nonsense in my own head, which I am powerless to stop. It generally ends in a bad nervous headache, unless I can sleep it off. The words which most frequently recur, and which I begin to watch for, are "*similibus horum*" (!), "caterpillars," and "the old man with the wooden spoon." I cannot at all account for their frequency. M. G.

ELECTRICITY IN DENTISTRY.

[659]—I observe in a recent number of KNOWLEDGE, what appears to be a reply to the inquiry of a correspondent under the head of "Dentist," whether the shock of a galvanic coil might not be made use of to deaden the pain of tooth extraction. Your reply is unfavourable to the idea, but as I happen to have had practical experience of its utility, I will proceed, with your permission, to relate what I know on the subject.

When I was living at Cork, about twenty years ago, I had occasion to go to a dentist to get a back tooth extracted which was aching, and not knowing any one in particular, I called on the first I came to, whose name I have quite forgotten, and can now only recollect that he lived on the south side of the South Mall. When I was seated in the operating chair he told me that he made use of a galvanic current to deaden the pain of extraction. To the best of my recollection I held in my hand one pole of a coil machine, while the other was in connection with the extracting forceps, and I well recollect that the passage of the current, which was very slight, caused a numbness in the tooth, which almost entirely overcame the pain. Being at the time a dabbler myself in electricity, I got into conversation with him, and examined his battery, which, I think, was a single cell "Smee," and he told me that he always used the coil, and never had any difficulty with patients since he commenced to use it.

I do not think he advertised his method of extraction, and as I left Cork shortly afterwards I lost sight of him. I never met with any dentist who used this method of extraction before or since; but possibly the publication of my experience may elicit some further information on the subject. THOS. C. HAINES.

Belfast, Nov. 6, 1882.

[This is news to us. The "shocks" were evidently very feeble indeed. We should be glad to hear more on the subject.—ED.]

SUGAR AND THE TEETH.

[660]—In answer to your correspondent, letter 607, page 364, Vol. II., during the process of refining, sugar is treated with sulphurous acid, which, I should think, is hurtful to the teeth. The low (that is, the very common) sugar would have the most effect on the teeth, and the best crystallized the least. IL ZUCCHERO.

After Dryden.

"Three Pens for three essential virtues famed,
The *Pickwick*, *Owl*, and *Waverley* were named,
The first in flexibility surpassed,
In ease the next, in elegance the last.
These points united with attractions new,
Have yielded other boons, the *Phaeton* and *Hindoo*."

Sample Box, with all the kinds, 1s. 1d. by Post.

"Let those write now who never wrote before;
And those who always wrote now write the more."—*Oban Times.*
Patentees of Pens and Penholders.
MACNIVEN & CAMERON, 33, BLAIR-STREET, EDINBURGH.
PENMAKERS TO HER MAJESTY'S GOVERNMENT OFFICES. Est. (1770.)

Answers to Correspondents.

This section is limited to one column as the maximum. Only a small proportion of the letters received can, therefore, be answered here. Many not answered may nevertheless be noted and acted upon. Letters raising religious, political, or personal questions, asking for text-book information, proposing class-room problems for solution, and so forth, pass at once to a receptacle specially provided for them. A stern and inflexible censor has been specially appointed to stand between a too-yielding Editor and those who thus unreasonably claim his attention and space which should be otherwise occupied.
NO LETTERS ANSWERED THROUGH THE POST.

ANNA BYRON DENNYS. Wheels are very ancient. No one knows when they were first used. We see pictures of them on all the most ancient carvings of all nations.—E. A. MARTIN, Dr. R. LEIGH, AN ANXIOUS MOTHER. Anti-corset articles in type before yours arrived, or would have inserted. You will find your arguments considered, and many others.—J. B. YOUNG notes that Rowney & Co. supply special water-colour paints very suitable for painting on glass.—A. Z. Such spots were visible.—E. HALIFAX. Best exercise for reasoning powers is, I think, the study of books in which matters scientific, legal, historical, and so forth are ably reasoned. The study of logic seems to impair them.—A CONSTANT READER AND WELL-WISHER. Expected rather to be sat upon for talking of those howling swells, as if (which is the case) they were just two possibly well-behaved possibly not well-behaved German persons. Certainly cannot be blamed for thinking unduly of Tel-el-Kebir: shades of Marlborough and Wellington defend us!—HITHERTO CONSTANT READER. Your kindly letter noted. Cannot find fault with views once my own. Emotion by no means dead through science; yet reason must be satisfied. Person in question so much better than kinsfolk, that probably even future judgment will be as you say; but one cannot but remember how kinsfolk were applauded in life and utterly scorned (by same persons) when no longer "Founts of Honour."—J. BALLOT. Thanks for pleasant letter. All success with your telescope.—FELLSIDE. (1) All in motion. (2) C. G. of universe would not be centre of motion for any star, any more than for earth or moon.—T. RADMORE, W. O. PROSSER, F. EBSTALL, J. N. MORRIS. Thanks; but sufficient attention given to spot for present.—F. D. BROWN. Many thanks.—C. H. W. HAMMICK. Brave, but not affording special evidence of reasoning. Thanks.—S. E. C. Howling papers sent us (marked at howling places) glanced at, W.-P.-basketed, names not noted. Science has nothing to howl at. Consider the tone of Darwin's letter in No. 57; how gentle, considerate, and modest. The last five words present his pure philosophy, "We can do our duty" (not "*Thou* shalt do what *I* consider *thy* duty"). Darwin imagined his correspondent would follow the line usual among gentlemen. Dear me! what could not some of us tell about the views of such men, if we felt free to publish private letters or utterances.—ATHROPA GYMBEIG. Seismometer is an instrument for measuring earth tremors. Many kinds exist. No space for description, which would require illustrating; and other subjects intervene.—A. BLACK. On return to town will ascertain the dif. cal. numbers.—H. B. (1) Not solar system gaseous as a whole, but its several parts. Why does not our air fly off, then? (2) Tresca's experiments require long and careful description. (3) Porous bodies would be soaked as a consequence of pressure. Consider case of block of wood, taken deep under water: pressure forces water in, so that wood never rises to surface unless dragged up. (4.) Apart from absorption by object-glass, you may have the same brilliancy, or less (with magnifying power 200), but never more: same brilliancy if object-glass large enough, viz., 200 times size of eye-pupil, say diameter about 3 inches. (5.) Pancratic eye-piece is one which can be so changed as to vary the power; not useful for sea-side telescopic purposes.—H. B. SHAW. So many such books. See notice at head of this column.—A. E. D. Battue sport (?) absurd, as you say; but hardly in our line.—A. SMITH. Can only say the comet affords no just cause for anxiety. It does not seem now likely to return for years; but if it were even absorbed shortly by the sun, it would do no harm, I feel assured.—M. J. HARDING. Maps now obtainable, 2d. each.—J. B. R. The theory "bosh."—E. SKINNER. Letter inserted. The numbers you mention are out of print. Cannot get them myself.—JAS. GRAHAM. Away from my books.—SENEX. Theory of tides given in most of the books quite wrong. Try Beckett's "Astronomy without Mathematics."—T. G. ELLIOTT. But the earth is *not* elongated from pole to pole.—W. W. W. Know of no good books to meet your case. I only remember two English Grammar rules learned at school, and one of *those* is wrong. Read freely books by good authors.—J. A. L. R. notes that "J.'s" problem is dealt with in Burchett's "Practical Plane Geometry" (W. Collins & Son: London and Glasgow).

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. XV.

WE have next to consider the various methods available for integrating the different expressions which come before us when we apply the methods of the integral calculus.

First some expressions can be integrated at once, because they have been already obtained as the differential coefficients of known functions. For these the following table, which gives all the differential coefficients of simple functions, will be found useful, and should always be held in the student's remembrance. We write $\frac{d}{dx}$ (function of x) for the differential coefficient of the function with respect to x.

	Differential Coefficient.	Deduced Integral.
Since	$\frac{d}{dx}(x^n) = nx^{n-1}$;	$\int x^n dx = \frac{x^{n+1}}{n+1}$
	$\frac{d}{dx}(\log_e x) = \frac{1}{x}$;	$\int \frac{dx}{x} = \log_e x$
	$\frac{d}{dx}(\log_a x) = \frac{1}{x \log_e a}$;	$\int \frac{dx}{x} = \log_e a \,.\, \log_a x = \log_e x$
	$\frac{d}{dx}(e^x) = e^x$;	$\int e^x dx = e^x$
	$\frac{d}{dx}(a^x) = a^x \,.\, \log_e a$;	$\int a^x dx = \frac{a^x}{\log_e a}$
	$\frac{d}{dx}(\sin x) = \cos x$;	$\int \cos x \, dx = \sin x$
	$\frac{d}{dx}(\cos x) = -\sin x$;	$\int \sin x \, dx = -\cos x$
	$\frac{d}{dx}(\tan x) = \frac{1}{\cos^2 x}$;	$\int \frac{dx}{\cos^2 x} = \tan x$
	$\frac{d}{dx}(\cot x) = \frac{-1}{\sin^2 x}$;	$\int \frac{dx}{\sin^2 x} = -\cot x$
	$\frac{d}{dx}(\sec x) = \frac{\sin x}{\cos^2 x}$;	$\int \frac{\sin x \, dx}{\cos^2 x} = \sec x$
	$\frac{d}{dx}(\operatorname{cosec} x) = \frac{-\cos x}{\sin^2 x}$;	$\int \frac{\cos x \, dx}{\sin^2 x} = -\operatorname{cosec} x$
	$\frac{d}{dx}\left(\sin^{-1}\frac{x}{a}\right) = \frac{1}{\sqrt{a^2 - x^2}}$;	$\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\cos^{-1}\frac{x}{a}\right) = -\frac{1}{\sqrt{a^2 - x^2}}$;	$\int \frac{dx}{\sqrt{a^2 - x^2}} = -\cos^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\tan^{-1}\frac{x}{a}\right) = \frac{a}{a^2 + x^2}$;	$\int \frac{dx}{a^2 + x^2} = \frac{1}{a}\tan^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\cot^{-1}\frac{x}{a}\right) = \frac{-a}{a^2 + x^2}$;	$\int \frac{dx}{a^2 + x^2} = -\frac{1}{a}\cot^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\sec^{-1}\frac{x}{a}\right) = \frac{a}{x\sqrt{x^2 - a^2}}$;	$\int \frac{dx}{x\sqrt{x^2 - a^2}} = \frac{1}{a}\sec^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\operatorname{cosec}^{-1}\right) = \frac{-a}{x\sqrt{x^2 - a^2}}$;	$\int \frac{dx}{x\sqrt{x^2 - a^2}} = -\frac{1}{a}\operatorname{cosec}^{-1}\frac{x}{a}$

The last six relations are, of course, reducible to three only, so far as integration is concerned. Since

$$\sin^{-1}\frac{x}{a} + \cos^{-1}\frac{x}{a} = \tan^{-1}\frac{x}{a} + \cot^{-1}\frac{x}{a} = \sec^{-1}\frac{x}{a} + \operatorname{cosec}^{-1}\frac{x}{a} = \frac{\pi}{2},$$

it is manifest that the second values given respectively to

$$\int \frac{dx}{\sqrt{a^2 - x^2}} \quad \int \frac{dx}{a^2 + x^2} \quad \text{and} \quad \int \frac{dx}{x\sqrt{x^2 - a^2}},$$

differ from the first only by a constant,—to wit, $\frac{\pi}{2}$ in the first of the three cases, and $\frac{\pi}{2a}$ in the other three cases.

Our Chess Column.

By Mephisto.

REPRINTS.

THE following position, sent us by Mr. Pearson, is (probably) the original of Eichstadt's problem. The position is as follows:—

White.—King on QR7, Rook on QKt8, Knights on Q5 and K7.

Black.—King on QR4, Knight on QR7.

White to play and mate in three moves.

The following problem by the late Rev. H. Bolton was sent to us by Mr. Miles:—

White.—King on QB8, Rook on KR5, Bishop on KKt3, Pawns on KKt2, QB4, QR3.

Black.—King on QB3, Pawns on QR5, KKt5.

White to play and mate in four moves.

THE following game was played by Mr. Steinitz, who is now on a visit to Philadelphia:—

STEINITZ GAMBIT.

White. Steinitz.	Black. Capt. Michaelis.	White. Steinitz.	Black. Capt. Michaelis.
1. P to K4	P to K4	13. Q to Q2 (*d*)	Castles (*e*)
2. QKt to B3	QKt to B3 (*a*)	14. B to R6 (ch)	K to Kt sq.
3. P to B4	P takes P	15. KR to K sq.	Q to Q4
4. P to Q4 (*b*)	Q to R5 (ch)	16. QR to B sq.	Kt to B3
5. K to K2	P to QKt3 (*c*)	17. Q to B2 (*f*)	B to Q3
6. Kt to Kt5	B to R3	18. B to QB4	Kt takes P (*g*)
7. P to B4	B takes Kt	19. Q to Q3	Q to KB4 (*h*)
8. P takes B	Q to R4 (ch)	20. B takes B	Q takes Q
9. Kt to B3	Q takes P (ch)	21. B takes Q	Kt takes Kt
0. K to B2	Q to Kt5	22. B tks P (ch (*i*)	K to Kt2
1. P to QR3	Q to K2	23. P takes Kt	R to QB sq.
2. B takes P	Q takes P	24. B to K5 and wins.	

NOTES.

(*a*) We prefer KKt to B3. Also B to B4 leads to an even game.

(*b*) This constitutes the Steinitz gambit. We do not consider it sound play. White thinks to be able to develop by Kt to B3, and then bringing his King to B2.

(*c*) Black must play carefully, as otherwise White will speedily bring his pieces into play, besides having two strong centre Pawns. White also threatens to win the weak KBP. Black's best move at this juncture is 5. P to Q4, which White might follow up by either 6. Kt takes P or 6. P takes P. If 5. P to Q4 6. Kt takes P / B to Kt5 (ch) 7. Kt to B3 / Castles 8. B takes P / Kt to B3, and Black has the advantage, for he will win one of the centre Pawns. 9. Kt takes Kt would be no good, on account of Kt takes P (ch); if P to B3 or B4, then KKt takes P, or if B to Kt3, then Q to R3. Also B takes BP is of no avail, *i.e.*, 9. B takes P / R takes Kt 10. P takes R / KKt takes P 11. B to K5 to prevent Kt takes P (ch) or B takes Kt (ch) 11. Kt takes B 12. P takes Kt / B to QB5 (as the White Queen cannot take the Knight, on account of Q to B7 (ch), followed by R to Q sq. winning the Queen) 13. Q to K sq. / Kt to B5 (ch) 14. K to Q sq. / R to Q sq. (ch) 15. B to Q3 / Kt takes KtP 16. Q takes Q / Kt takes Q 17. R to B sq. / Kt takes Kt and wins. If again, in reply to the proposed move of 5. P to Q4, White should play 6. P takes P, the game would proceed thus:—5. P to Q4 6. P takes P / B to Kt5 (ch) 7. Kt to B3 / Kt to K2 8. P to Q6 / P takes P 9. B takes P / Kt to B4 10. K to Q3 / Q to R5, and we think Black has no disadvantage.

(*d*) Threatening R to K sq., B takes P would not be good, on account of P to Q3.

(*e*) White has a great facility for deploying his pieces; for that reason Steinitz believes in this risky gambit. Castles has the disadvantage of exposing the King to the attack of the two Bishops, but, as in most of Steinitz's games, although apparently he threatens nothing in particular, yet it is difficult to see what to do. If Q to Q4, then White would obtain a good game by R to B sq., threatening by B to B4, R to K sq., or P to Q5, to bring all his pieces into fine play, and make things in general uncomfortable for Black. Our choice would have been 13. Kt to B3, if now 14. R to K sq., then B to K2. White, of course, will not take the Queen; probably he would play B to KKt5, to which Black's reply would be Q to Q4, but his game would be very difficult.

(*f*) To guard against Kt to K5 (ch) and also with the option of playing P to Kt4 and Kt5.

(*g*) A miscalculation; he ought to have played Q to KR4.

(*h*) Black thought this move saves his piece. White cannot capture the Knight on account of B to B4, or if 20. Q takes Q, then Kt takes Q, but as will be seen White wins.

(*i*) This is the flaw. By being able to take this Pawn with a check he wins the Knight.

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Sir,—Herewith enclosed please find detailed solution of that beautiful composition—Problem No. 60, by John Simpson—which appears in the Chess Column of Knowledge for November 24. I have spent many hours trying to solve this problem, and have at last been rewarded by arriving at the correct result. The more I study the position the more beautiful it seems, and one cannot help thinking what an exceedingly fine game chess is, and how extremely difficult of mastery. G. H. Bonner.

SOLUTION OF PROBLEM No. 60.

By John Simpson, p. 424.

1. K to Q8

This move, which apparently does not influence the position in any way, leaves Black the option of four different moves with his King,—viz., to B3, B5, K5, and Q4. Besides this remarkable freedom of action of Black's King, he has three additional moves with his Pawns.

We shall now consider the various defences.

(*a*) 1. K to B3
2. Kt takes P — 2. K to B2 or K4
3. Q to Kt7 or Q4 mate.

(*b*) if 1. K to B5
2. KKt to B3 and Q mates on Q4.

(*c*) if 1. K to K5
2. KKt to B3 and mate as before.

(*d*) if 1. K to Q4
2. Q to K3 — 2. Anything.
3. QKt to Kt6 mate.

(*e*) if 1. P to B5
2. KKt to B5 and mates with Q as in (*a*)

(*f*) if 1. P to K4
2. Q to K3 (ch) — 2. K to Q3 or B3
3. Q to K7 mate.

(*g*) if 1. P to Kt6
2. Q to K3 (ch) — 2. K to Q4
3. QKt to Kt6 mate, or
2. K to B3
3. Q to K7 mate.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Ch. Herbert.—Problem not suitable.

A. W. was shocked to find no solution of Problem No. 60 in our No. 57. He will be further "shocked" by seeing that his own solution was wrong, as also No. 61.

Pity, oh, Keeffe; your solution is wrong.

C. W. Hammick.—You might have sent the first move.

Correct solution of Problem No. 59 received from J. J. A. Problem No. 60 from G. H. Bonner, Henry Planck, R. T. Berrow. No. 61, W. J. Reynolds, C. Hammick. No. 62, Henry Planck, A. W., Francis J. Drake, W. H. B. H. No. 64, John Watson, H. Seward. No. 65, H. Seward.

Incorrect solutions received from John Watson (63 and 65), J. Y. B., W. Watson, Old Meldrum, W. Kinsey Dover, Schmucke, J. P. Berrow, R. J. P.

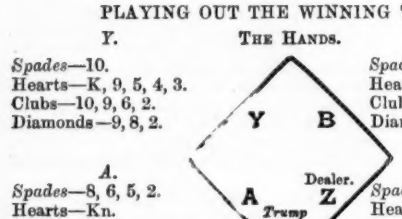
Further solutions received from I. A. M., 63, 4, 5. John O'Keeffe, 63, 4. W., 60 to 65. John Simpson, 63, 4, 5. Berrow, 63, 4. H. V. T., 61, 2, 3, 5. W., 64, T. T. Dorrington, T. S. L., 62, Geo. H. Bonner, Tyro, R. J. P., 63, 4. G. Woodcock, 61, 2, 4, 5.

G. W.—14. B to K6 is certainly better; but better still is to play 3. P to Q4.

Our Whist Column.

By "Five of Clubs."

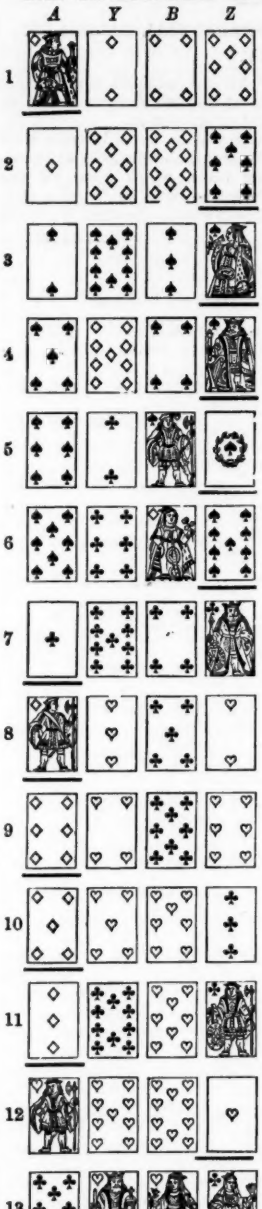
PLAYING OUT THE WINNING TRUMP.



Score :— $\left\{ \begin{matrix} A, B, = 0 \\ Y, Z, = 1 \end{matrix} \right.$

THE PLAY.

Note.—The card underlined wins the trick, and card below leads next round.



MR. LEWIS'S NOTES.

1. *A* has no other lead.

2. In this position *Z* should not trump with the penultimate. The latter is the turn-up card, and as *Z* is about to play out his tierce major, it is better if the trumps fall that *Y* should be left in no doubt. As, however, the Eight and the turn-up remain in after the play of the three rounds, *A* may be credited with the Eight, for if *Z* had had the Eight, he ought to have trumped with it. The fall of the Diamonds at trick 2 leaves *Z* in doubt as to whether *Y* or *B* has the Queen, but when at trick four *Y* discards Diamond Nine, he cannot have the Queen, as by discarding the Nine he would be giving up the tenace.

5. *Z* continues the trump to draw two for one.

6. At this point *Z* should have cleared the Club suit. He must make two by cards, even if *B* has Knave and Queen of Diamonds, by refusing to trump, and discarding the two small Hearts. By drawing the last trump before clearing the Clubs, he enables *B* to take advantage of the information *Y* gave him when he discarded the Nine of Diamonds. *B*, therefore, properly discards Diamond Queen, thus leaving *A*, if he has a *rentrée* card, in full possession of the suit.

7. Behold the result! *A* is left with four good Diamonds, and making six tricks, saves the game. If at trick six, instead of drawing the trump, *Z* had played Club King, *A* and *B* could have made but three tricks, Club King, Diamond King, and Diamond Queen; of course *Z* would not have trumped the Diamond Queen. The drawing of the last trump was the more blamable because *Y*, at the fourth trick, had practically told *Z* he could not depend upon him for a trick in the Diamond suit.

Note.—The above is the second of the three interesting games kindly sent to us and annotated by Mr. F. H. Lewis. Apart from the lesson specially conveyed by it, it is specially instructive in showing the advantage of carefully playing bad hands. Both *Y* and *B* have poor hands, and as the game proceeds, it becomes clear to both players that all they can do is to play with careful reference to the indications as to their partner's hands. This they do. *Y* does all in his power to save his partner from the mistake into which nevertheless *Z* falls. As it happens, the enemy gains more than *Y Z*, but that is not *Y*'s fault. *B* carefully clears his partner's suit by throwing away the winning Diamond left alone in his hand.

Vacnol.—Whether with weak trumps (not more than three), you should or should not force partner after he has had the lead and refrained from leading trumps, would depend on circumstances. In most cases, *not*. For he is likely enough to have just such strength in trumps as would guard both your hands if he is not forced, but leave you powerless if he is. Yet there are many cases in which it may be better to make a certain trick by forcing, than trust to maintaining trumps against the enemy. The rule, If weak, refrain from forcing partner, is one to which there are many exceptions.—Five of Clubs.